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EXAMINER

RUGGLES, JOHN S

ART UNIT

PAPER NUMBER

1756

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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3 MONTHS

12/22/2006

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

## Office Action Summary

Application No.

10/658,372

Applicant(s)

SHOKI, TSUTOMU

Examiner

John Ruggles

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 02 November 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1 and 3-21 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1 and 3-14 is/are rejected.
- 7) ☒ Claim(s) 15-21 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 02 November 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- ☒ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date 11/2/06.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- ☐ Notice of Informal Patent Application
- ☒ Other: Attachment A.

## **DETAILED ACTION**

### ***Response to Amendment***

In the current 11/2/06 submission, claims 1 and 3-12 are currently amended, claim 2 is currently cancelled, and new claims 13-21 are currently added. Therefore, only claims 1 and 3-21 remain pending and under consideration.

The previous objection of Figure 4 is withdrawn in view of the currently presented replacement sheet for this drawing, as indicated below.

The previous objections to the title and abstract are maintained for the reason given below. Also, the currently proposed amended abstract is not responsive to the previous objections numbered (2)-(4), which are repeated below.

The previous specifically exemplified objections to the specification numbered (1)-(4) are withdrawn in view of the current specification amendments. However, further exemplified reasons for objection to the specification are stated below.

The previous claims objections numbered (1)-(2) are withdrawn in view of the current claim amendments and accompanying remarks, as indicated below. However, the current claim amendments have also necessitated a new claims objection, which is set forth below.

The previous rejection of claims under the second paragraph of 35 U.S.C. 112 is revised below as necessitated by the current claim amendments.

The previous art rejections of claims under 35 U.S.C. 103(a) are revised below as necessitated by the current claim amendments.

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The current 11/2/06 amendment submission is non-responsive to the previous nonstatutory obviousness-type double patenting (ODP) rejections, which are updated below as necessitated by the current claim amendments.

Applicant's arguments with respect to instant claims 1 and 3-14 have been considered, but they are either unpersuasive or moot in view of the revised ground(s) of rejection set forth below.

Claim 15 would be allowable if rewritten or amended to overcome the claim objection set forth below. Claims 16-21 would also be allowable if rewritten (A) to overcome the claim objection set forth below and (B) to include all of the limitations of the base claim and any intervening claims. As allowable subject matter has been indicated, Applicant's reply must either comply with all formal requirements or specifically traverse each requirement not complied with, as stated below.

#### ***Drawings***

The previous objection of Figure 4 is withdrawn in view of the currently presented replacement sheet for this drawing.

#### ***Specification***

The previous objections to the title and abstract are maintained below, at least because the currently proposed amended title and abstract (on pages 2-3 of the current submission) have not been entered since they are both non-compliant due to the absence of any markings to specifically show the changes made relative to the prior versions thereof. A copy of instructions for revised amendment practice under 37 CFR 1.121 (effective since 7/30/03) are included as "Attachment A" with this Office action for Applicant's convenience. Also, the currently

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proposed amended abstract is not responsive to the previous objections numbered (2)-(4), which are repeated below.

The previous specifically exemplified objections to the specification numbered (1)-(4) are withdrawn, along with a few others not specifically pointed out, in view of the current specification amendments (on pages 4-5 of the current submission). However, further exemplified reasons for objection to the specification are stated below.

The title of the invention is not properly descriptive. A new title is required that is clearly indicative of the invention to which the claims must be directed.

The following title is suggested: --METHOD OF PRODUCING A REFLECTION [[TYPE]] MASK BLANK, METHOD OF PRODUCING A REFLECTION [[TYPE]] MASK, AND METHOD OF PRODUCING A SEMICONDUCTOR DEVICE--.

The abstract of the disclosure is objected to because: (1) it is written as a single sentence that is confusing; (2) in line 1, "reflection type mask blank" should be changed to --reflection [[type]] mask blank-- to more properly describe the enabled scope of the instant reflection mask blank (it is not clear what the word "type" was meant to include); (3) in lines 4-5 and 7-9, the statements about avoidance and suppression of interface mixing by heat treatment are not fully supported by the statements throughout the specification that the *change over lapsed time* in properties (e.g., compressive stress, etc.) of the multilayer reflector are suppressed by heat treatment (see e.g., page 4 line 25, page 5 line 20-22, comparison of Figure 4 (without heat treatment) and Figure 2 (with heat treatment), etc.); and (4) neither the claimed reflection mask nor the claimed method of producing a semiconductor device are included in this abstract.

Correction is required. See MPEP § 608.01(b).

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35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is still replete with terms, which are not clear, concise and exact. The specification should again be revised carefully in order to more fully comply with 35 U.S.C. 112, first paragraph. Examples of some remaining unclear, inexact or verbose terms used in the specification are: (5) at page 3 lines 7-8 and 24, "the decrease" should be changed to --[[the]] a decrease--, at both occurrences; (6) at page 5 line 19, "The multilayer reflection film of the type" should be clarified (e.g., to --[[The]] This multilayer reflection film of ~~the type~~--, etc.); (7) at page 5 line 23, "forming a pattern on the absorber layer" must be corrected to --forming a pattern [[on]] in the absorber layer--; and (8) similar or further clarifications or corrections should also be made throughout the specification, wherever appropriate (at e.g., page 7 line 3, page 14 lines 11-13, page 24 line 6, etc.). Note that due to the number of errors, those listed here are merely examples of the corrections needed and do not represent an exhaustive list thereof.

Appropriate correction is again required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

### ***Claim Objections***

The previous claims objections numbered (1)-(2) are withdrawn in view of the current claim amendments and accompanying remarks. However, the current claim amendments have also necessitated a new claims objection, which is set forth below.

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Claims 15-21 are objected to because of the following informalities: in claim 15 line 12, "subs rate" is understood to be a misspelling of the word --substrate--. Appropriate correction is required. Claims 16-21 depend from claim 15.

***Claim Rejections - 35 USC § 112***

The previous rejection of claims under the second paragraph of 35 U.S.C. 112 is revised below as necessitated by the current claim amendments.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1 and 3-14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 1 lines 10-17, it is unclear what "the heat treatment" in line 10 actually causes to be changed in the reflection mask blank having a multilayer reflection film and an absorber layer thereon, other than interfacial mixing between adjacent layers of the multilayer reflection film. However, for the purpose of this Office action and in order to advance the prosecution of this application, the currently amended recitations in lines 10-17 describing intended use limitations are interpreted reasonably broadly to mean that the heat treatment causing such interfacial mixing between adjacent layers of the multilayer reflection film on the reflection mask blank under the same conditions would inherently make the resulting reflection mask blank suitable for the same intended uses as instantly recited. Claims 3-7 and 13-14 depend from claim 1.

In each of claims 6-7 and 11, the word "type" renders each of these claim(s) indefinite, because the claim(s) include elements not actually disclosed (those encompassed by "type"),

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thereby rendering the scope of the claim(s) unascertainable. See MPEP § 2173.05(b) Part E “Type”. Therefore, for the purpose of this Office action and in order to expedite the prosecution of this application, each of claims 6-7 and 11 have been interpreted with this word deleted -- [[type]]--, at each occurrence. Claim 12 depends from claim 11.

In claim 8 lines 4-5, the language “the multilayer reflection film comprises alternate layers of Mo and Si method comprising:” is unclear about the meaning of the phrase “Si method” in this amended context. However, for the purpose of this Office action, the above language is interpreted to mean --the multilayer reflection film comprises alternate layers of Mo and Si, the method comprising:--. Claims 9-12 depend from claim 8.

### ***Claim Rejections - 35 USC § 103***

The previous art rejections of claims under 35 U.S.C. 103(a) are revised below as necessitated by the current claim amendments.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 6, and 13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Mirkanimi (US 2001/0019803) or Mirkarimi et al. (US 6,319,635) in view of either Nguyen et al. (US 6,048,652), Levinson (Principles of Lithography, SPIE --The International Society for Optical Engineering), or Barbee, Jr. et al. (US 6,396,900).

Mirkanimi '19803 teaches reticles or masks, blanks therefore having multilayer reflective coatings or films for extreme ultraviolet (EUV) lithography, and methods of mitigating defects in



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such EUV multilayer reflective masks and blanks by depositing buffer and reflective coatings (of e.g., alternating layers of ion beam sputtered molybdenum (Mo)/silicon (Si), Mo/Be, Ru/Si, Si/Mo/Ru, etc., paragraph [0019]) and stress annealing (heat treating) such multilayer coatings at a compatible temperature in the range of about 100°C to 600°C for 0.001 hours (0.06 minutes) to 48 hours (which reads on the *instant claim 8* heat treatment at a temperature of 50°C or more for a time period of 3 minutes or more, as well as reading on the *instant claim 14* heat treatment at a temperature between 50°C and 135°C for a time period of 3 minutes or more, e.g., annealing such multilayer coatings after deposition at a temperature of 300°C, 200°C, etc.), to achieve the desired stress and annealed surface roughness (claims, [0013], [0068]). The annealing or heating can be carried out during and/or after multilayer deposition ([0041], which is understood to mean that heat treatment is carried out before subsequent steps such as overcoating with an absorber and patterning using an overlying resist film to form an EUV multilayer reflective mask for lithography, *instant claims 6 and 13*). The multilayer buffer coating can be either the same material as the high reflecting multilayer film or a different material (abstract). Reflective coatings for EUV lithography are well known in the art ([0035]). The same ion beam sputtering tool can be used for depositing both the multilayer buffer coating and the overlying reflective coating ([0020]). The annealing or heating can be either slow or rapid, with the annealing temperature and time varying depending on the composition and intended function of the multilayer coating (e.g., the multilayer buffer coating is permitted to have greater intermixing at layer interfaces and may be different in structure from the multilayer reflective film that is optimized for high reflectivity to EUV, etc., [0016], [0018], [0021], [0051]).

Mirkarimi et al. '635 teach similar reticles or masks, blanks therefore having multilayer reflective coatings or films for EUV lithography, and methods of mitigating defects in such EUV multilayer reflective masks and blanks by depositing buffer coatings under multilayer reflective films (of e.g., alternating layers of ion beam sputtered molybdenum (Mo)/silicon (Si), Mo/Be, Ru/Si, Si/Mo/Ru, etc., col. 3 lines 8-18) and stress annealing (heat treating) such multilayer coatings to achieve the desired stress and annealed surface roughness (col. 8 line 40 to col. 10 line 33). The annealing or heating can be carried out during and/or after multilayer deposition (col. 5 lines 14-15, which is understood to mean that heat treatment is carried out before subsequent steps such as overcoating with an absorber and patterning using an overlying resist film to form an EUV multilayer reflective mask for lithography, *instant claims 6 and 13*). The buffer coating can be either the same material as the reflective multilayer film or a different material (col. 3 lines 1-2). Reflective coatings for EUV lithography are well known in the art (col. 4 lines 5-6). The same ion beam sputtering tool can be used for depositing both the multilayer buffer coating and the overlying reflective coating (col. 3 lines 19-26). The annealing or heating is carried out for the composition and intended function of the multilayer coating (e.g., the multilayer buffer coating is permitted to have greater intermixing at layer interfaces and may be different in structure from the multilayer reflective film that is optimized for high reflectivity to EUV, etc., col. 2 lines 49-51, col. 3 lines 3-7, col. 7 lines 24-26, 45-47, 52-55).

While specifically teaching heat treatment during and/or after multilayer deposition for optimization of the multilayer reflective film on the EUV mask or blank for less intermixing between layers (of e.g., Mo/Si, etc.) than is tolerated in a (multilayer) buffer coating (of e.g., Mo/Si, etc.) and other aspects of the instant claims, neither Mirkarimi '19803 nor Mirkarimi et

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al. '635 specifically teach that such heat treatment of the multilayer reflective film suppresses progressive mixing at the interface between reflective layers (of e.g., Mo/Si, etc.) after formation due to additional thermal factors (e.g., to make the resulting reflective mask blank suitable for the instantly claimed intended uses, etc., *instant claim 1*).

However, it is known in the art of making EUV multilayer reflective masks that Mo/Si alternating layers begin to intermix at about 150°C and this reduces reflectivity of the multilayer stack, so only low-temperature processes (e.g., for subsequent deposition and etching of an absorber layer through an overlying patterned resist film on the multilayer stack of a reflective mask blank to form a patterned EUV multilayer reflective mask, etc., *instant claim 6*) are used for fabricating such EUV multilayer reflective masks (as taught by Levinson (SPIE)). In fact, it is strongly preferred that any such processing occur at a temperature of less than about 150°C (including subsequent patterning of an absorber layer through an overlying patterned resist film on a multilayer reflective mask blank to form a patterned reflective mask, *instant claim 6*), because this would reasonably be expected to protect the integrity and quality of the Mo/Si reflective multilayer (as taught by Nguyen et al. col. 7 lines 3-7 and col. 8 lines 58-61).

Furthermore, Barbee Jr. et al. teach that Mo/Si multilayers cannot be exposed to temperatures above 120°C even for a short time (including subsequent etching procedures and thermal cycling to pattern masks having such reflective multilayers by patterning of an absorber layer through an overlying patterned resist film on a multilayer reflective mask blank to form a patterned reflective mask, *instant claim 6*), because the activation energy at the Mo/Si interface is so low that further diffusion and the growth of molybdenum silicide would be inevitable at this temperature. The temperature of reflective Mo/Si multilayers on a reflective mask blank must be

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kept at or below 120°C in order to avoid causing instability and degradation of the reflectance and multilayer period thickness needed for reflecting the desired EUV or soft x-ray wavelength (col. 1 lines 51-61).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention in the method of producing an EUV multilayer reflective mask blank involving heat treatment of a multilayer (of e.g., Mo/Si reflective film, etc.) on a reflective mask blank and subsequent patterning into an EUV multilayer reflective mask (as taught by Mirkanimi '19803 or Mirkarimi et al. '635) to keep the temperatures for the heat treatment and other subsequent processes to less than about 150°C (as taught by Levinson (SPIE) or Nguyen et al.), or particularly less than 120°C (as taught by Barbee Jr. et al.), because this would reasonably be expected to avoid intermixing of Mo/Si that would cause reduction in reflectivity of the multilayer stack (as taught by Levinson (SPIE)), protect the integrity and quality of the Mo/Si reflective multilayer (as taught by Nguyen et al.), or particularly to suppress further or progressive diffusion and the growth of molybdenum silicide that would cause instability and degradation of the reflectance and multilayer period thickness needed for reflecting the desired EUV wavelength (as taught by Barbee Jr. et al.). Thus, heat treatment of the multilayer reflective film below about 150°C or particularly below 120°C would be expected to inherently suppress progressive mixing at the interface between the EUV reflective multilayers (of e.g., Mo/Si, etc.) on the mask blank and on the corresponding patterned EUV multilayer reflective mask after formation due to additional thermal factors when subsequent processing temperatures (e.g., for deposition and/or etching of an absorber layer for the mask, etc.) are kept below such a heat treatment temperature. Heat treatment under these conditions would reasonably be expected

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to make the EUV multilayer reflective mask blank and the resulting EUV multilayer reflective patterned mask inherently suitable for the same intended uses as instantly recited (*instant claims 1 and 6*).

Claims 3-4, 7-9, and 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Mirkanimi (US 2001/0019803) or Mirkarimi et al. (US 6,319,635) in view of either Nguyen et al. (US 6,048,652), Levinson (Principles of Lithography, SPIE --The International Society for Optical Engineering), or Barbee, Jr. et al. (US 6,396,900), and further in view of Kumada et al. (US 2003/0152845).

While teaching several aspects of the instant claims, neither Mirkanimi '19803, Mirkarimi et al. '635, Nguyen et al., Levinson (SPIE), nor Barbee, Jr. et al. specifically teach a chemically amplified resist for patterning the absorber layer on the multilayer reflection mask blank (*instant claims 3 and 9*) or heat treatment at a temperature that is between 50°C and the baking temperature of the resist (*instant claims 4 and 8*).

Kumada et al. teach a mask blank and a method of patterning to form a mask (title, abstract). The method includes irradiating or exposing a chemically amplified resist film 3 (*instant claims 3 and 9*) on the mask blank 6 shown in Figure 2A with either an active light or a radiant ray (e.g., electron beam exposure, etc.) as shown in Figure 2B, and then heat treatment of the exposed chemically amplified resist, causing an acid catalytic reaction [0051]. The resist is patterned by developing as shown in Figure 2C [0052] and an underlying light blocking or absorber layer on the mask blank is etched through the patterned chemically amplified resist as shown in Figure 2D, followed by removing residual resist to yield a patterned photomask or mask as shown in Figure 2E [0053]. This patterned mask has a high dimensional uniformity and

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semiconductor devices made from this mask also have a high dimensional uniformity for high quality semiconductor devices in high yields [0054]. In Example 1, a chemically amplified resist was baked and dried on a hot plate at 110°C for 10 minutes before exposure by an electron beam, then the resist is post-exposure baked again under the same conditions (at 110°C for 10 minutes), followed by developing to pattern the resist with a good shape in exact accordance with design dimensions, and further processing to form a patterned mask in the same manner as described and shown in Figures 2D-2E [0069, 0071-0072].

It would have been obvious to one of ordinary skill in the art at the time of the invention in the method of producing an EUV multilayer reflective mask blank involving heat treatment of a multilayer (of e.g., Mo/Si reflective film, etc.) on a reflective mask blank and subsequent processes for patterning this mask blank into an EUV multilayer reflective mask at temperatures less than about 150°C or particularly less than 120°C (as taught by Mirkanimi '19803 or Mirkarimi et al. '635 and Levinson (SPIE), Nguyen et al., or Barbee Jr. et al.) to utilize a chemically amplified resist (*instant claims 3 and 9*) for patterning the absorber layer on the multilayer reflection mask blank that would only require baking or heat treatment of the resist at a relatively low temperature of 110°C (as taught by Kumada et al.) that is below that which would cause problems with the multilayer reflective film. This is because a chemically amplified resist for patterning the multilayer reflective mask would be expected to provide a high dimensional uniformity in the mask and in resulting semiconductor devices made from this mask, as well as providing a patterned mask having a good shape in exact accordance with design dimensions and leading to high quality semiconductor devices in high yields (as taught by Kumada et al., *instant claims 7 and 11-12*). At least the lower portion of the heat treatment

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range of about 100°C to 110°C (for a time period of 0.06 minutes to 48 hours) taught by Mirkanimi '19803 reads on the instant heat treatment time period of 3 minutes or more at a heat treatment temperature of between 50°C and the baking temperature (e.g., 110°C, etc.) of the chemically amplified resist that is taught by Kumada et al. (*instant claims 4 and 8*).

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Mirkanimi (US 2001/0019803) or Mirkarimi et al. (US 6,319,635) in view of either Nguyen et al. (US 6,048,652), Levinson (Principles of Lithography, SPIE --The International Society for Optical Engineering), or Barbee, Jr. et al. (US 6,396,900), and further in view of Mangat et al. (US 6,596,465).

While teaching some aspects of the instant claim, neither Mirkanimi '19803, Mirkarimi et al. '635, Nguyen et al., Levinson (SPIE), nor Barbee, Jr. et al. specifically teach heat treatment of the multilayer reflection film in a heated liquid (*instant claim 5*).

Mangat et al. teach a method of manufacturing a semiconductor component that includes exposure to EUV with a reflective lithographic mask having a patterned absorber layer (title, abstract). Patterning of an absorber on a EUV reflective mask blank to form a patterned reflective mask includes pattern transfer into absorber layers (260, 250, and 240 as shown in Figure 2) and subsequent stripping of residual resist by a 10 minute immersion in a sulfuric acid and hydrogen peroxide solution heated to approximately 85°C to 90°C in order to avoid higher temperatures encountered during an alternative resist ashing process (that would typically be performed at greater than approximately 150°C and would cause damage to the multilayer reflective mask blank (col. 3 lines 46-49 and col. 4 lines 33-39)).

It would have been obvious to one of ordinary skill in the art at the time of the invention in the method of producing an EUV multilayer reflective mask blank involving heat treatment of a multilayer (of e.g., Mo/Si reflective film, etc.) on a reflective mask blank and subsequent processes for patterning this mask blank into an EUV multilayer reflective mask at temperatures less than about 150°C or particularly less than 120°C (as taught by Mirkanimi '19803 or Mirkarimi et al. '635 and Levinson (SPIE), Nguyen et al., or Barbee Jr. et al.) to carry out the heat treatment of the multilayer reflection film by immersion in a liquid heated to approximately 85°C to 90°C that can also be used for stripping of residual resist without a separate step therefore, because this would reasonably be expected to avoid higher temperatures that would cause damage to the multilayer reflective film while still being expected to inherently suppress progressive mixing at the interface between the EUV reflective multilayers (of e.g., Mo/Si, etc.) on the mask blank and even avoiding an additional step to shorten and/or simplify the method of producing the multilayer reflective mask blank and the resulting patterned multilayer reflective mask (*instant claim 5*).

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over either Mirkanimi (US 2001/0019803) or Mirkarimi et al. (US 6,319,635) in view of either Nguyen et al. (US 6,048,652), Levinson (Principles of Lithography, SPIE --The International Society for Optical Engineering), or Barbee, Jr. et al. (US 6,396,900), further in view of Kumada et al. (US 2003/0152845), and further in view of Mangat et al. (US 6,596,465).

While teaching some aspects of the instant claim, neither Mirkanimi '19803, Mirkarimi et al. '635, Nguyen et al., Levinson (SPIE), nor Barbee, Jr. et al. specifically teach heat treatment of



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the multilayer reflection film in a heated liquid at a temperature that is between 50°C and the baking temperature of the resist (*instant claim 10*).

The teachings of Kumada et al. and Mangat et al. are discussed above.

It would have been obvious to one of ordinary skill in the art at the time of the invention in the method of producing an EUV multilayer reflective mask blank involving heat treatment of a multilayer (of e.g., Mo/Si reflective film, etc.) on a reflective mask blank and subsequent processes for patterning this mask blank into an EUV multilayer reflective mask at temperatures less than about 150°C or particularly less than 120°C (as taught by Mirkanimi '19803 or Mirkarimi et al. '635 and Levinson (SPIE), Nguyen et al., or Barbee Jr. et al.) to carry out the heat treatment of the multilayer reflection film by immersion in a liquid heated to approximately 85°C to 90°C and to use a chemically amplified resist baked at 110°C (as taught by Kumada et al. and Mangat et al.). This is because a chemically amplified resist for patterning the multilayer reflective mask would reasonably be expected to provide a high dimensional uniformity in the mask and in resulting semiconductor devices made from this mask, as well as providing a patterned mask having a good shape in exact accordance with design dimensions and leading to high quality semiconductor devices in high yields (as taught by Kumada et al.). The use of a chemically amplified resist would also be reasonably expected to avoid a higher baking temperature that would otherwise have caused damage to the multilayer reflective film, while still allowing sufficient heat treatment to inherently suppress progressive mixing at the interface between the EUV reflective multilayers (of e.g., Mo/Si, etc.) on the mask blank. At least the lower portion of the heat treatment range of about 100°C to 110°C (for a time period of 0.06 minutes to 48 hours) taught by Mirkanimi '19803 as well as the liquid heat treatment of 85°C to

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90°C taught by Mangat et al. reads on the instant heat treatment time period of 3 minutes or more at a heat treatment temperature of between 50°C and the baking temperature of the chemically amplified resist (e.g., 110°C, etc.) that is taught by Kumada et al. (*instant claim 10*).

### ***Double Patenting***

The current 11/2/06 amendment submission is non-responsive to the previous nonstatutory obviousness-type double patenting (ODP) rejections, which are updated below as necessitated by the current claim amendments.

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1, 6, and 13-14 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claim 23 of U.S. Patent No. 5,958,627 (Shoki '627) in view of either Mirkanimi (US 2001/0019803) or Mirkarimi et al. (US 6,319,635), and further in view of either Nguyen et al. (US 6,048,652), Levinson (Principles of Lithography, SPIE --The

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International Society for Optical Engineering), or Barbee, Jr. et al. (US 6,396,900). The conflicting claim of the Shoki '627 patent is not identical to the instant claims, at least because the Shoki '627 patent claim recites a method of producing an x-ray mask blank having an absorber film on an x-ray transparent film on a substrate that includes stress annealing or heat treatment, whereas the instant claims recite a method of producing a multilayer reflection mask blank having an absorber layer on a multilayer reflection film on a substrate that involves heat treatment to avoid progressive mixing at an interface between layers due to thermal factors in the reflection film. The Shoki '627 patent claim also does not specifically recite other instantly claimed limitations taught by the other references that are discussed above.

However, it would still have been obvious to one of ordinary skill in the art at the time of the invention that an x-ray mask and an EUV multilayer reflective mask are both usable for lithographic exposure of resists at overlapping or similar wavelengths. Other differences between the Shoki '627 patent claim and the instant claims are met by Mirkanimi '19803) or Mirkarimi et al. '635) and either Nguyen et al. (US 6,048,652), Levinson (SPIE), or Barbee, Jr. et al., each of which have been discussed above. Heat treatment of the multilayer reflective film below about 150°C or particularly below 120°C (reading on the *instant claim 14* heat treatment at a temperature between 50°C and 135°C for a time period of 3 minutes or more) before other layers are formed on the substrate of the reflective mask blank (*instant claim 13*) would be expected to inherently suppress progressive mixing at the interface between the EUV reflective multilayers (of e.g., Mo/Si, etc.) on the mask blank and on the corresponding patterned EUV multilayer reflective mask after formation due to additional thermal factors when subsequent processing temperatures (e.g., for deposition and/or etching of an absorber layer for the mask,

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etc.) are kept below such a heat treatment temperature. Heat treatment under these conditions would reasonably be expected to make the EUV multilayer reflective mask blank and the resulting EUV multilayer reflective patterned mask inherently suitable for the same intended uses as instantly recited (*instant claims 1 and 6*).

Claims 1, 6-7, and 13-14 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-2 and 8-9 of U.S. Patent No. 7,056,627 (Shoki et al. '627) in view of either Mirkanimi (US 2001/0019803) or Mirkarimi et al. (US 6,319,635), and further in view of either Nguyen et al. (US 6,048,652), Levinson (Principles of Lithography, SPIE --The International Society for Optical Engineering), or Barbee, Jr. et al. (US 6,396,900). The conflicting claims of the Shoki et al. '627 patent are not identical to the instant claims, at least because the Shoki et al. '627 patent claims recite a method of manufacturing a multilayer reflection mask blank having a stress correction film along with an absorber film on a multilayer reflection film on a substrate that includes stress-affecting heat treatment, a method of manufacturing a reflection mask from the multilayer reflection mask blank, and a method of manufacturing a semiconductor device by lithography using the multilayer reflection mask. The instant claims recite a method of producing a multilayer reflection mask blank having an absorber layer on a multilayer reflection film on a substrate without a stress correction film that involves heat treatment to avoid progressive mixing at an interface between layers due to thermal factors in the reflection film, a method of producing a multilayer reflection mask from the multilayer reflection mask blank, and a method of manufacturing a semiconductor device by lithography using the multilayer reflection mask. The Shoki et al. '627 patent claims also do not

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specifically recite other instantly claimed limitations that are taught by the other references, which are discussed above.

However, it would still have been obvious to one of ordinary skill in the art at the time of the invention that the heat treatment of the multilayer reflective mask blank having a stress correction film in the Shoki et al. '627 patent claims could have alternatively been performed on a multilayer reflective mask blank without a stress correction film in the manner taught by either Mirkanimi '19803) or Mirkarimi et al. '635) and either Nguyen et al. (US 6,048,652), Levinson (SPIE), or Barbee, Jr. et al., each of which are discussed above. Heat treatment of the multilayer reflective film below about 150°C or particularly below 120°C (reading on the *instant claim 14* heat treatment at a temperature between 50°C and 135°C for a time period of 3 minutes or more) before other layers are formed on the substrate of the reflective mask blank (*instant claim 13*) would be expected to inherently suppress progressive mixing at the interface between EUV reflective multilayers (of e.g., Mo/Si, etc.) on the mask blank and on the corresponding patterned EUV multilayer reflective mask after formation due to additional thermal factors when subsequent processing temperatures (e.g., for deposition and/or etching of an absorber layer for the mask, etc.) are kept below such a heat treatment temperature. Heat treatment under these conditions would reasonably be expected to make the EUV multilayer reflective mask blank and the resulting EUV multilayer reflective patterned mask inherently suitable for the same intended uses as instantly recited (*instant claims 1 and 6*). The method of producing a semiconductor device by lithography using such a heat treated multilayer reflective mask (*instant claim 7*) would also have been obvious from the Shoki et al. '627 patent claim 9 in combination with

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either Mirkanimi '19803) or Mirkarimi et al. '635) and either Nguyen et al. (US 6,048,652), Levinson (SPIE), or Barbee, Jr. et al. for the above stated reasons.

***Response to Arguments***

Applicant's arguments with respect to instant claims 1 and 3-14 have been considered, but they are either unpersuasive or moot in view of the revised ground(s) of rejection set forth above.

***Allowable Subject Matter***

Claim 15 would be allowable if rewritten or amended to overcome the claim objection set forth above in this Office action.

Claims 16-21 would be allowable if rewritten (A) to overcome the claim objection set forth above in this Office action and (B) to include all of the limitations of the base claim and any intervening claims.

As allowable subject matter has been indicated, applicant's reply must either comply with all formal requirements or specifically traverse each requirement not complied with. See 37 CFR 1.111(b) and MPEP § 707.07(a).

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after

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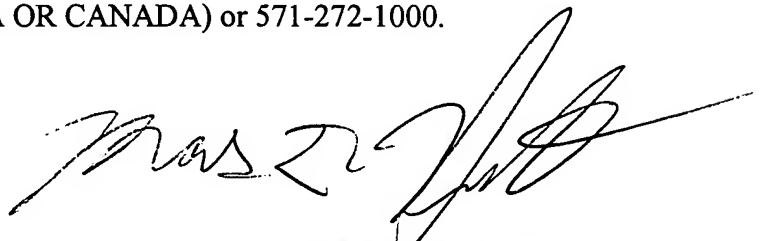
the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

jsr



**MARK F. HUFF**  
**SUPERVISORY PATENT EXAMINER**  
**TECHNOLOGY CENTER 1700**

**REVISED AMENDMENT PRACTICE: 37 CFR 1.121 CHANGED  
COMPLIANCE IS MANDATORY - Effective Date: July 30, 2003**

All amendments filed on or after the effective date noted above must comply with revised 37 CFR 1.121. See Final Rule: **Changes To Implement Electronic Maintenance of Official Patent Application Records** (68 Fed. Reg. 38611 (June 30, 2003)), posted on the Office's website at: <http://www.uspto.gov/web/patents/ifw/> with related information. The amendment practice set forth in revised 37 CFR 1.121, and described below, replaces the voluntary revised amendment format available to applicants since February 2003. **NOTE: STRICT COMPLIANCE WITH THE REVISED 37 CFR 1.121 IS REQUIRED AS OF THE EFFECTIVE DATE (July 30, 2003).** The Office will notify applicants of amendments that are not accepted because they do not comply with revised 37 CFR 1.121 via a Notice of Non-Compliant Amendment. See MPBP 714.03 (Rev. 1, Feb. 2003). The non-compliant section(s) will have to be corrected and the entire corrected section(s) resubmitted within a set period.

***Bold underlined italic font has been used below to highlight the major differences between the revised 37 CFR 1.121 and the voluntary revised amendment format that applicants could use since February, 2003.***

Note: The amendment practice for reissues and reexamination proceedings, except for drawings, has not changed.

**REVISED AMENDMENT PRACTICE**

**I. Begin each section of an amendment document on a separate sheet:**

Each section of an amendment document (e.g., Specification Amendments, Claim Amendments, Drawing Amendments, and Remarks) must begin on a separate sheet. Starting each separate section on a new page will facilitate the process of separately indexing and scanning each section of an amendment document for placement in an image file wrapper.

**II. Two versions of amended part(s) no longer required:**

37 CFR 1.121 has been revised to **no longer require** two versions (a clean version and a marked up version) of each replacement paragraph or section, or amended claim. Note, however, the requirements for a clean version and a marked up version for substitute specifications under 37 CFR 1.125 have been retained.

**A) Amendments to the claims:**

Each amendment document that includes a change to an existing claim, cancellation of a claim or submission of a new claim, must include a complete listing of all claims in the application. After each claim number in the listing, the status must be indicated in a parenthetical expression, and the text of each pending claim (with markings to show current changes) must be presented. The claims in the listing will replace all prior claims in the application.

- (1) The current status of all of the claims in the application, including any previously canceled, not entered or withdrawn claims, must be given in a parenthetical expression following the claim number using only one of the following seven status identifiers: (original), (currently amended), (canceled), (withdrawn), (new), (previously presented) and (not entered). The text of all pending claims, including withdrawn claims, must be submitted each time any claim is amended. Canceled and not entered claims must be indicated by only the claim number and status, without presenting the text of the claims.
- (2) The text of all claims being currently amended must be presented in the claim listing with markings to indicate the changes that have been made relative to the immediate prior version. The changes in any amended claim must be shown by underlining (for added matter) or strikethrough (for deleted matter) with 2 exceptions: (1) for deletion of five characters or fewer, double brackets may be used (e.g., [[error]]); and (2) if strikethrough cannot be easily perceived (e.g., deletion of the number "4" or certain punctuation marks), double brackets must be used (e.g., [[4]]). As an alternative to using double brackets, however, extra portions of text may be included before and after text being deleted, all in strikethrough, followed by including and underlining the extra text with the desired change (e.g., number 4 as number 14 as). An accompanying clean version is not required and should not be presented. Only claims of the status "currently amended," and "withdrawn" that are being amended, may include markings.
- (3) The text of pending claims not being currently amended, including withdrawn claims, must be presented in the claim listing in clean version, i.e., without any markings. Any claim text presented in clean version will constitute an assertion that it has not been changed relative to the immediate prior version except to omit markings that may have been present in the immediate prior version of the claims.



## Attachment A (continued)

- (4) A claim being canceled must be listed in the claim listing with the status identifier "canceled"; the text of the claim must not be presented. Providing an instruction to cancel is optional.
- (5) Any claims added by amendment must be presented in the claim listing with the status identifier "(new)"; the text of the claim must not be underlined.
- (6) All of the claims in the claim listing must be presented in ascending numerical order. Consecutive canceled, or not entered, claims may be aggregated into one statement (e.g., Claims 1 - 5 (canceled)).

### Example of listing of claims (use of the word "claim" before the claim number is optional):

Claims 1-5 (canceled)

Claim 6 (previously presented): A bucket with a handle.

Claim 7 (withdrawn): A handle comprising an elongated wire.

Claim 8 (withdrawn): The handle of claim 7 further comprising a plastic grip.

Claim 9 (currently amended): A bucket with a ~~green~~ blue handle.

Claim 10 (original): The bucket of claim 9 wherein the handle is made of wood.

Claim 11 (canceled)

Claim 12 (not entered)

Claim 13 (new): A bucket with plastic sides and bottom.

### B) Amendments to the specification:

Amendments to the specification, including the abstract, must be made by presenting a replacement paragraph or section or abstract marked up to show changes made relative to the immediate prior version. An accompanying clean version is not required and should not be presented. Newly added paragraphs or sections, including a new abstract (instead of a replacement abstract), must not be underlined. A replacement or new abstract must be submitted on a separate sheet, 37 CFR 1.72. If a substitute specification is being submitted to incorporate extensive amendments, both a clean version (which will be entered) and a marked up version must be submitted as per 37 CFR 1.125.

The changes in any replacement paragraph or section, or substitute specification must be shown by underlining (for added matter) or strikethrough (for deleted matter) with 2 exceptions: (1) for deletion of five characters or fewer, double brackets may be used (e.g., [[error]]); and (2) if strikethrough cannot be easily perceived (e.g., deletion of the number "4" or certain punctuation marks), double brackets must be used (e.g., [[4]]). As an alternative to using double brackets, however, extra portions of text may be included before and after text being deleted, all in strikethrough, followed by including and underlining the extra text with the desired change (e.g., number 4 as number 14 as)

### C) Amendments to drawing figures:

Drawing changes must be made by presenting replacement figures which incorporate the desired changes and which comply with 37 CFR 1.84. An explanation of the changes made must be presented either in the drawing amendments, or remarks, section of the amendment, and may be accompanied by a marked-up copy of one or more of the figures being amended, with annotations. Any replacement drawing sheet must be identified in the top margin as "Replacement Sheet" and include all of the figures appearing on the immediate prior version of the sheet, even though only one figure may be amended. Any marked-up (annotated) copy showing changes must be labeled "Annotated Marked-up Drawings" and accompany the replacement sheet in the amendment (e.g., as an appendix). The figure or figure number of the amended drawing(s) must not be labeled as "amended." If the changes to the drawing figure(s) are not accepted by the examiner, applicant will be notified of any required corrective action in the next Office action. No further drawing submission will be required, unless applicant is notified.

Questions regarding the submission of amendments pursuant to the revised practice set forth in this flyer should be directed to: Elizabeth Dougherty or Gena Jones, Legal Advisors, or Joe Narcavage, Senior Special Projects Examiner, Office of Patent Legal Administration, by e-mail to [patentpractice@uspto.gov](mailto:patentpractice@uspto.gov) or by phone at (703) 305-1616.